

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Senoo et al.
Appl. No.: 09/162,992
Conf. No.: 9466
Filed: September 30, 1998
Title: GEL ELECTRODE SECONDARY CELL
Art Unit: 1795
Examiner: Tracy M. Dove
Docket No.: 3712174-00037

AFFIDAVIT UNDER 37 C.F.R. § 1.132

Sir:

I hereby state as follows:

1. My experience and qualifications are as follows:

I am currently an employee of Sony Corporation.

I have worked for Sony Corporation for 18 years.

I have worked in the field of gel electrode secondary cell for over 5 years.

I have a doctor in Applied Chemistry graduate course from KEO University,
received on September, 1994.

2. I am one of the named inventors of the above-identified patent application and am, therefore, familiar with the inventions disclosed therein.

3. I have reviewed the outstanding Office Action dated May 5, 2011 pending against the above-identified patent application. In addition to considering the outstanding Office Action, I have reviewed the references cited therein, as well as the pending claims.

4. The present invention is directed, in part, toward a gel electrolyte secondary cell including an electrolyte containing propylene carbonate and a graphite material that comprises sintered meso-carbon micro-beads. One having ordinary skill in the art would understand that graphite materials exhibit widely varying physical properties and are thus distinguishable depending on the starting material and the production process.

5. Furthermore, the degree of decomposition of propylene carbonate in a graphite cell varies depending on the physical properties of the graphite material. For example, with respect to the size of the graphite powder particles, the conventional understanding at the time of the invention was that a graphite material having a larger particle size has a smaller surface area and thus is less susceptible to decomposition of propylene carbonate. If, however, the graphite material has a small particle size, the decomposition of propylene carbonate is significant. If decomposition of propylene carbonate occurs, there is a discharge capacity loss that lowers the charging/discharging efficiency of the battery. Therefore, the conventional understanding was that it was desirable to use graphite having a larger particle size in a battery containing a propylene-carbonate based electrolytic solution.

6. With respect to the present disclosure, it has been surprisingly found that it is possible to use graphite having a small particle size of 100 μm or less (and a corresponding specific surface area of 0.1 m^2/g or more) in combination with a propylene carbonate electrolyte while maintaining a high charging/discharging efficiency. As demonstrated in Table 1 of the Specification, a coin-shaped gel electrode cell containing a lithium metal foil positive electrode, an electrolyte composed of 35 mol % propylene carbonate and 65 mol % ethylene carbonate, and a negative electrode comprising various graphite materials was evaluated. See, Specification, page 4, paragraphs 59-60 and 65; pages 4-5, paragraph 67; Table 1. When the graphite negative electrode material was a fired material of meso-carbon micro-beads having a particle size such that the specific surface area is 3.6 m^2/g and 1.2 m^2/g , respectively, initial charging/discharging efficiencies of 82.8% and 82.6% were obtained. See, Specification, page 4, paragraph 62; page 5, paragraph 70; Table 1. In contrast, when the same cell was used and the graphite negative electrode material was a fired petroleum coke having a specific surface area of 4.5 m^2/g , the initial charging/discharging efficiency was significantly lower – 61%. See, Specification, page 5, paragraph 74; Table 1.

7. Similarly, Table 2 demonstrates initial charging/discharging efficiencies of 74.5% and 74.1% in a thin type gel electrolyte cell containing propylene carbonate when a graphite material comprised of sintered meso-carbon micro-beads is used as the anode material. See, Specification, page 5, paragraph 82; page 6, paragraph 87; Table 2. However, a significantly lower efficiency of only 56% is achieved in the same gel electrolyte cell when the anode material is substituted with a graphite material obtained by firing petroleum coke. See, Specification, page 6, paragraph 88; Table 2. One of ordinary skill in the art would thus understand that a graphite material comprising sintered meso-carbon micro-beads having the claimed particle size in accordance with the present claims achieves an unexpectedly high charging/discharging efficiency when combined with propylene carbonate and is thus distinguishable from a graphite material comprising fired petroleum coke.

8. *MacFadden* fails to disclose or suggest a graphite material comprising sintered meso-carbon micro-beads in combination with propylene carbonate. Instead, *MacFadden* merely discloses a carbon anode active material that may be in the form of graphite generally and fails to specify the particular type of graphite material used in its anode. See, *MacFadden*, column 4, lines 9-13. However, a graphite material comprising sintered meso-carbon micro-beads is distinguishable from a graphite material comprising, for example, fired petroleum coke. When a graphite anode active material comprising sintered meso-carbon micro-beads is used in a battery containing propylene carbonate, much higher initial charging/discharging efficiencies of 82.8% and 82.6% are obtained as compared with a graphite material comprising fired petroleum coke.

9. *Maruyama* also fails to disclose or suggest a graphite material comprising sintered meso-carbon micro-beads in combination with propylene carbonate. Instead, *Maruyama* merely discloses a battery wherein "[t]he carbon used as the active material may be properly selected from natural or artificial graphite." See, *Maruyama*, column 5, lines 9-10. Nowhere does *Maruyama* specify the particular type of graphite material used in its battery.

10. *Ozaki* fails to disclose or suggest a graphite material comprising sintered meso-carbon micro-beads having the claimed size in combination with a solvent containing propylene carbonate. *Ozaki* teaches a battery containing graphitized mesophase carbon micro beads having a particle size of 5.7-6 μm and a specific surface area of 3.0-12.5 m^2/g but fails to teach using such graphitized material in combination with propylene carbonate. See, *Ozaki*, column 3, lines 25-67; column 4, lines 1-15. Instead, *Ozaki* merely discloses an electrolyte containing ethylene carbonate, diethyl carbonate and methyl propionate. See, *Ozaki*, column 4, lines 54-58. *Ozaki*, pursuant to the conventional wisdom at the time of the invention, teaches that propylene carbonate generates unfavorable side reactions with its small-sized graphite particles and is therefore not suitable for use with its graphite particles. See, *Ozaki*, column 7, lines 5-16.

11. *Akashi* fails to disclose or suggest a graphite material comprising sintered meso-carbon micro-beads having the claimed size in combination with a solvent containing propylene carbonate. For example, *Akashi* teaches generally using "graphite" as a carbonaceous negative electrode material but in its examples discloses using propylene carbonate with a lithium metal anode. See, *Akashi*, page 5, lines 3-16; page 10, lines 29-40; page 11, lines 1-6.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001, Title 18, United States Code, and that willful false statements may jeopardize the validity of this patent and any patent issuing therefrom.

Date: July 28, 2011

Jadashi Senoo

Name: